## REMARKS/ARGUMENTS

This is a response to the Office Action of May 19, 2006. Reconsideration of this patent application is requested.

Claims 1-13, 15-18, 20, 21, 24-31, 33, 34, 36-39, and 41 are pending in the application.

Claims 1-13, 15-18, 20, 21, 24-31, 33, 34, 36-39, and 41 are rejected.

Claim 29 is objected to.

Claims 2, 3, 4, 28, 29, and 34 are hereby canceled.

### The Claimed Invention

The claimed invention presents a system and method for generation and storage of pressurized hydrogen gas, comprising:

(a) a hydrogen gas generator which comprises:

a first compartment comprising at least one chemical hydride for irreversibly generating pressurized hydrogen gas by a chemical reaction of the at least one chemical hydride;

(b) a hydrogen storage canister in fluid communication with the hydrogen gas generator for storing the pressurized hydrogen gas, wherein the hydrogen storage canister comprises at least one metal hydride; and

(c) at least one hydrogen conditioner in fluid communication with the hydrogen gas generator and the hydrogen storage canister wherein the at least one hydrogen conditioner comprises a vessel which contains one or more desiccant materials.

### Amendments to the Specification:

Paragraph [0013] is amended to conform to Claim 1 as filed. No new matter is added by this amendment to the specification.

**Amendments to the Claims:**

Independent Claim 1 (currently amended) has been amended to incorporate limitations from Claim 2 and Claim 4. No new matter is added by this amendment to the claim.

Claim 5 has been amended to depend from Claim 1 instead of canceled Claim 4. No new matter is added by this amendment to Claim 5.

Claim 8 has been amended to delete ammonia from the Markush list, thereby further narrowing the scope of claim 8. No new matter is added by this amendment to Claim 8.

Claim 30 has been amended to depend from Claim 18 instead of canceled Claim 29. No new matter is added by this amendment to Claim 30.

Claim 33 has been amended to incorporate limitations from Claim 34 and Claim 4. No new matter is added by this amendment to Claim 33.

Claim 36 has been amended to delete ammonia from the Markush list, thereby further narrowing the scope of claim 36. No new matter is added by this amendment to Claim 36.

**Claim Objections**

The Examiner objected to Claim 29, stating:

> "There is not antecedent basis in either claim 1 or claim 18 for the "hydrogen conditioner" set forth in applicants' claim 29. "

Applicants have canceled Claim 29 thereby making Examiner's objection moot.

**Claim Rejections – 35 USC §103**

The Examiner has advised Applicants of their obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the Examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a). Applicants acknowledge that the subject matter of the claims was commonly owned at the time any inventions covered therein were made.

Claims 1-13, 15-18, 20, 21, 24-31, 33, 34, 36-39, and 41 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Application Publication No. US2002/0081235 A1 to *Baldwin*.et al. in view of U.S. Patent 4,489,564 to Hausler et al.

The Examiner states:

> "The difference between the applicants' claims and the Baldwin et al. reference is that applicants' claims 1, 15, 26, 27 and 33 set forth that the hydrogen storage canister comprises a metal hydride.
>
> U.S. Patent 4,489,564 to Hausler reports the use of a hydride storage canister for hydrogen (please see col. 1 lines 6-8). The storage material within the canister may be a metal alloy containing titanium, zirconium, chromium and manganese which evidently react with the gaseous hydrogen inserted into the canister to form metal hydrides (please see col. 12 lines 10-22). The Hausler patent reports the advantages of the canister as being able to store hydrogen in the metal hydride form without problems, safely and in a small space (please see col. 1 lines 14-26).
>
> It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process and apparatus described in the Baldwin et al. reference by substituting the metal hydride hydrogen-storage canister of taught in col. 1 lines 6-22 in U.S. Patent 4,489, 564 in lieu of the "storage tank (7)" described in paragraph no. 0041 in the Baldwin et al. reference, in the manner required by at least applicants' claims 1, 15, 26, 27, and 33, because of the expected advantages of avoiding problems and storing the hydrogen safely while using only a small space, as suggested by the disclosure set forth in col. 1 lines 13-16 in U.S. Patent 4,489,564 to Hausler et al."

Water (moisture) and other impurities tend to poison metal hydrides.

In paragraph [0034] Myasnikov et al. U.S. Patent Application Publication US 2005/0211573 (prior art of record) states:

> "The Ti-Fe alloy system, which has been considered as a typical and superior material of the titanium alloy systems, has the advantages that it is relatively inexpensive and the hydrogen dissociation equilibrium pressure of hydrogen is several atmospheres at room temperature. However, since it requires a high temperature of about 350°C. and a high pressure of over 30 atmospheres for initial hydrogenation. Also, it has a hysteresis problem which hinders the complete release of hydrogen stored therein. *The Ti-Fe alloy is also easily poisoned by moisture*, which will be present within the heating pack." (*emphasis added*)

Singh et al. U.S. Patent No. 5,686,196, col. 4, lines 37-44 states:

> "When metal hydride storage is used in accordance with the present invention, *it is preferable to purify the hydrogen stream prior to contact with the metal in order to reduce or eliminate oxygen, carbon dioxide, water, and other constituents which tend to poison the metal hydride*. A suitable hydrogen purifier comprises a Pd, Pd--Ag membrane. The hydrogen purifier may significantly prolong the life of the hydrogen storage system." (*emphasis added*)

Baldwin et al. disclose water removal by a condenser and a condenser comprising a dilute sodium hydroxide solution.

Baldwin et al., paragraph [0041] states, in part:

> "The generated hydrogen gas, under pressure, flows from the reactor (5) through the check valve (2) into the condenser (6). The other check valve (2) prevents the pressure from forcing gas into the water storage tank (1). *In the condenser (6), water is condensed out of the generated hydrogen gas* which then passes into the storage tank (7) for eventual use. The stored higher pressure hydrogen is made available through a pressure regulator (8) for distribution to the end use application. The pressure gauges (4) indicate the pressure in both the reactor (5) and the storage tank (7). Condensed water is periodically drained from the condenser (6) through the valve (9). " (*emphasis added*)

Baldwin et al., paragraph [0046] states:

> "The chemical container (**32**) is shown as a cylindrical pressure vessel fitted with a porous sintered metal filter element ( **30**) at the top, and connected to the metering pump (**20**) through external piping (**21**). The lower portion of the chemical container is filled with sodium hydroxide pellets (**31**). The metering pump (**20**) is connected to the water tank (**19**). The condenser (**24**) is a cylindrical pressure vessel connected to the reactor through external piping (**10**) which extends almost to the bottom of the condenser. It is connected to the pressure regulator ( **26**) output through external piping (**25**). *The lower half of the condenser (24) is filled with a dilute solution of sodium hydroxide* (**27**). Again, other configurations may be used. " (*emphasis added*)

The hydrogen effluent stream from the condensers of Baldwin et al. contains significant water.

A condenser, even at a temperature as low as 1°C, would provide an effluent gas having a water mole fraction of about 0.0065. According to Table 3-5, page 3-45 of Perry's Chemical Engineers' Handbook, 6th Edition, the vapor pressure of water at 1°C is 4.926 mmHg. At 1 atm. (760 mmHg), the mole fraction of water is about 0.0065. Table 3.5 is included in Appendix A.

A condenser having a dilute solution of sodium hydroxide would similarly have a significant water content. According to Table 3-27, page 3-73 of Perry's Chemical Engineers' Handbook, 6th Edition, at a concentration of 10 g. sodium hydroxide in 100 g. water, the partial pressure of water is 16.0 mmHg at 20°C. At 1 atm. (760 mmHg), this translates to a water mole fraction of about 0.021. Table 3-27 is included in Appendix A.

Significant water content in the effluent hydrogen stream, as achieved through the use of the condensers of Baldwin et al., would therefore poison the metal hydride of Hausler et al.

Consequently, one of ordinary skill in the art would not make the combination of Baldwin et al. and Hausler et al.

Applicants respectfully submit that the Examiner has failed to establish a *prima facie* obviousness rejection of the independent claims 1 and 33, in view of Baldwin et al. and Hausler et al and Applicants respectfully request the Examiner to withdraw such rejection.

Since the independent claims are *per se* nonobvious, the dependent Claims 5-13, 15-18, 20, 21, 24-27, 30, 31, 36-39, and 41 are nonobvious. According to MPEP 2143.03, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious.

Applicants respectfully submit that the Examiner has failed to establish a *prima facie* obviousness rejection of Claims 5-13, 15-18, 20, 21, 24-27, 30, 31, 36-39, and 41 in view of Baldwin et al. and Hausler et al. and Applicants respectfully request the Examiner to withdraw such rejection.

Applicants' claimed invention as amended comprises water removal by use of at least one desiccant material. Desiccant materials provide orders of magnitude lower water content in the effluent stream than the condensers of Baldwin et al. and are therefore not functionally equivalent.

From the Desiccant Selection Guide available on the jtbaker website, www.jtbaker.com, included as Appendix B, the mole fraction of water present in an effluent air stream after passing through a desiccant containing vessel may be calculated. One (1) liter of dry air is about 0.04159 moles. The residual water after passing through the desiccant ranges from 0.001 mg/L for molecular sieve to about 0.25 mg/L for calcium chloride. Calcium sulfate and DRIERITE provide a residual water content of about 0.005 mg/L. A water content of 0.001 mg/L translates to a water mole fraction of about 0.000001. A water content of 0.25 mg/L translates to a water mole fraction of about 0.000334. Hence, one of the least effective desiccants, calcium chloride, provides more than an order of magnitude better water removal than the most effective condenser at 1°C; 0.000334 water mole fraction for calcium chloride versus 0.0065 water mole fraction for the 1°C condenser.

It is therefore evident that the condensers of Baldwin et al. and the hydrogen conditioner with desiccant of the present invention are not equivalent.

**Double Patenting**

The Examiner has provisionally rejected Claims 1-13, 15-18, 20, 21, 24-31, 33, 34, 36-39 and 41 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-26 of copending Application No. 11-188,465.

The Examiner states:

> "A showing that the inventions were commonly owned at the time the invention in this application was made will preclude a rejection under 35 U.S.C. 103(a) based upon the commonly assigned case as a reference under 35 U.S.C. 102(f) or (g), or 35 U.S.C. 102(e) for applications pending on or after December 10, 2004. "

Applicant acknowledges the provisional obviousness-type double patenting rejection.

The inventors of the present invention, Graham, Xu, and Meski, having an obligation to assign their patent rights to Air Products and Chemicals, Inc. are the same Graham, Xu, and Meski listed as inventors of copending Application No. 11/188,465. Copending Application No. 11/188,465 also lists inventor Horninger, who also has an obligation to assign patent rights to Air Products and Chemicals, Inc.

The inventions were commonly owned at the time the inventions were made.

The present Application No. 10/712,195 has an earlier filing date than the co-pending Application No. 11/188,465. At this time, no action on the merits has been mailed for the co-pending Application No. 11/188,465.

No further action regarding the provisional obviousness-type double patenting rejection for the present Application is believed necessary at this time.

**Prior Art of Record, Not Relied Upon by Examiner**

Applicants acknowledge that U.S. Pat. App'n Pub. US 2006/0088467 A1, U.S. Pat. App'n Pub. US 2005/0211573 A1, U.S. Patent 7,037,483 B2, U.S. Patent 7,029,600 B2, U.S. Patent 6,991,770 B2, U.S. Patent 6,742,650 B2, U.S. Patent 6,651,701 B2, and U.S. Patent 6,638,348 B2 have been cited as prior art of record, but not relied upon by the Examiner, although considered pertinent by the Examiner to Applicants' disclosure.

## SUMMARY

For all of the foregoing reasons, Applicant respectfully requests withdrawal of the rejection of Claims 1, 5-13, 15-18, 20, 21, 24-27, 30, 31, 33, 36-39, and 41 and earnestly solicit a Notice of Allowance thereof.

Respectfully submitted,

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APPENDIX A

# PERRY'S CHEMICAL ENGINEERS' HANDBOOK

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# VAPOR PRESSURES OF PURE SUBSTANCES

## UNITS CONVERSIONS

For this subsection, the following units conversions are applicable:

$°F = \frac{9}{5}\,°C + 32$.

To convert millimeters of mercury to pounds-force per square inch, multiply by 0.01934.

## ADDITIONAL REFERENCES

Additional compilations of vapor-pressure data include Boublik, Fried, and Hala, *The Vapor Pressures of Pure Substances*, Elsevier, Amsterdam, 1984. See also Hirata, Ohe, and Nagahama, *Computer Aided Data Book of Vapor-Liquid Equilibria*, Kodansha/Elsevier, Tokyo, 1975; Weishaupt, *Landolt-Börnstein New Series Group IV*, vol. 3: *Thermodynamic Equilibria of Boiling Mixtures*, Springer-Verlag, Berlin, 1975; Wichterle, Linek, and Hala, *Vapor-Liquid Equilibrium Data Bibliography*, Elsevier, Amsterdam, 1973; suppl. 1, 1976; suppl. 2, 1982.

**TABLE 3-3 Vapor Pressure of Water Ice from −15 to 0°C***

mmHg

| t, °C. | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| −14 | 1.361 | 1.348 | 1.336 | 1.324 | 1.312 | 1.300 | 1.288 | 1.276 | 1.264 | 1.253 |
| −13 | 1.490 | 1.477 | 1.464 | 1.450 | 1.437 | 1.424 | 1.411 | 1.399 | 1.386 | 1.373 |
| −12 | 1.632 | 1.617 | 1.602 | 1.588 | 1.574 | 1.559 | 1.546 | 1.532 | 1.518 | 1.504 |
| −11 | 1.785 | 1.769 | 1.753 | 1.737 | 1.722 | 1.707 | 1.691 | 1.676 | 1.661 | 1.646 |
| −10 | 1.950 | 1.934 | 1.916 | 1.899 | 1.883 | 1.866 | 1.849 | 1.833 | 1.817 | 1.800 |
| − 9 | 2.131 | 2.112 | 2.093 | 2.075 | 2.057 | 2.039 | 2.021 | 2.003 | 1.985 | 1.968 |
| − 8 | 2.326 | 2.306 | 2.285 | 2.266 | 2.246 | 2.226 | 2.207 | 2.187 | 2.168 | 2.149 |
| − 7 | 2.537 | 2.515 | 2.493 | 2.472 | 2.450 | 2.429 | 2.408 | 2.387 | 2.367 | 2.346 |
| − 6 | 2.765 | 2.742 | 2.718 | 2.695 | 2.672 | 2.649 | 2.626 | 2.603 | 2.581 | 2.559 |
| − 5 | 3.013 | 2.987 | 2.962 | 2.937 | 2.912 | 2.887 | 2.862 | 2.838 | 2.813 | 2.790 |
| − 4 | 3.280 | 3.252 | 3.225 | 3.198 | 3.171 | 3.144 | 3.117 | 3.091 | 3.065 | 3.039 |
| − 3 | 3.568 | 3.539 | 3.509 | 3.480 | 3.451 | 3.422 | 3.393 | 3.364 | 3.336 | 3.308 |
| − 2 | 3.880 | 3.848 | 3.816 | 3.785 | 3.753 | 3.722 | 3.691 | 3.660 | 3.630 | 3.599 |
| − 1 | 4.217 | 4.182 | 4.147 | 4.113 | 4.079 | 4.045 | 4.012 | 3.979 | 3.946 | 3.913 |
| − 0 | 4.579 | 4.542 | 4.504 | 4.467 | 4.431 | 4.395 | 4.359 | 4.323 | 4.287 | 4.252 |

* For data at 0(0.2)–30(2)–98°C, see p. 2324, "Handbook of Chemistry and Physics," 40th ed., Chemical Rubber Publishing Co.

**TABLE 3-4 Vapor Pressure of Liquid Water from −16 to 0°C***

mmHg

| t, °C. | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| −15 | 1.436 | 1.425 | 1.414 | 1.402 | 1.390 | 1.379 | 1.368 | 1.356 | 1.345 | 1.334 |
| −14 | 1.560 | 1.547 | 1.534 | 1.522 | 1.511 | 1.497 | 1.485 | 1.472 | 1.460 | 1.449 |
| −13 | 1.691 | 1.678 | 1.665 | 1.651 | 1.637 | 1.624 | 1.611 | 1.599 | 1.585 | 1.572 |
| −12 | 1.834 | 1.819 | 1.804 | 1.790 | 1.776 | 1.761 | 1.748 | 1.734 | 1.720 | 1.705 |
| −11 | 1.987 | 1.971 | 1.955 | 1.939 | 1.924 | 1.909 | 1.893 | 1.878 | 1.863 | 1.848 |
| −10 | 2.149 | 2.134 | 2.116 | 2.099 | 2.084 | 2.067 | 2.050 | 2.034 | 2.018 | 2.001 |
| − 9 | 2.326 | 2.307 | 2.289 | 2.271 | 2.254 | 2.236 | 2.219 | 2.201 | 2.184 | 2.167 |
| − 8 | 2.514 | 2.495 | 2.475 | 2.456 | 2.437 | 2.418 | 2.399 | 2.380 | 2.362 | 2.343 |
| − 7 | 2.715 | 2.695 | 2.674 | 2.654 | 2.633 | 2.613 | 2.593 | 2.572 | 2.553 | 2.533 |
| − 6 | 2.931 | 2.909 | 2.887 | 2.866 | 2.843 | 2.822 | 2.800 | 2.778 | 2.757 | 2.736 |
| − 5 | 3.163 | 3.139 | 3.115 | 3.092 | 3.069 | 3.046 | 3.022 | 3.000 | 2.976 | 2.955 |
| − 4 | 3.410 | 3.384 | 3.359 | 3.334 | 3.309 | 3.284 | 3.259 | 3.235 | 3.211 | 3.187 |
| − 3 | 3.673 | 3.647 | 3.620 | 3.593 | 3.567 | 3.540 | 3.514 | 3.487 | 3.461 | 3.436 |
| − 2 | 3.956 | 3.927 | 3.898 | 3.871 | 3.841 | 3.813 | 3.785 | 3.757 | 3.730 | 3.702 |
| − 1 | 4.258 | 4.227 | 4.196 | 4.165 | 4.135 | 4.105 | 4.075 | 4.045 | 4.016 | 3.986 |
| − 0 | 4.579 | 4.546 | 4.513 | 4.480 | 4.448 | 4.416 | 4.385 | 4.353 | 4.320 | 4.289 |

* Computed from the above table with the aid of the thermodynamic equation

$$\log_{10}\frac{p_w}{p_i} = \frac{-1.1489t}{273.1+t} - 1.330\times10^{-5}t^2 + 9.084\times10^{-8}t^3$$

**TABLE 3-5 Vapor Pressure of Liquid Water from 0 to 100°C***

mmHg

| t, °C. | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4.579 | 4.613 | 4.647 | 4.681 | 4.715 | 4.750 | 4.785 | 4.820 | 4.855 | 4.890 |
| 1 | 4.926 | 4.962 | 4.998 | 5.034 | 5.070 | 5.107 | 5.144 | 5.181 | 5.219 | 5.256 |
| 2 | 5.294 | 5.332 | 5.370 | 5.408 | 5.447 | 5.486 | 5.525 | 5.565 | 5.605 | 5.645 |
| 3 | 5.685 | 5.725 | 5.766 | 5.807 | 5.848 | 5.889 | 5.931 | 5.973 | 6.015 | 6.058 |
| 4 | 6.101 | 6.144 | 6.187 | 6.230 | 6.274 | 6.318 | 6.363 | 6.408 | 6.453 | 6.498 |
| 5 | 6.543 | 6.589 | 6.635 | 6.681 | 6.728 | 6.775 | 6.822 | 6.869 | 6.917 | 6.965 |
| 6 | 7.013 | 7.062 | 7.111 | 7.160 | 7.209 | 7.259 | 7.309 | 7.360 | 7.411 | 7.462 |
| 7 | 7.513 | 7.565 | 7.617 | 7.669 | 7.722 | 7.775 | 7.828 | 7.882 | 7.936 | 7.990 |
| 8 | 8.045 | 8.100 | 8.155 | 8.211 | 8.267 | 8.323 | 8.380 | 8.437 | 8.494 | 8.551 |
| 9 | 8.609 | 8.668 | 8.727 | 8.786 | 8.845 | 8.905 | 8.965 | 9.025 | 9.086 | 9.147 |

**TABLE 3-5 Vapor Pressure of Liquid Water from 0 to 100°C*** **(*Concluded*)**

| t, °C. | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 9.209 | 9.2 1 | 9.333 | 9.395 | 9.458 | 9.521 | 9.585 | 9.649 | 9.714 | 9.779 |
| 11 | 9.844 | 9.910 | 9.976 | 10.042 | 10.109 | 10.176 | 10.244 | 10.312 | 10.380 | 10.449 |
| 12 | 10.518 | 10.588 | 10.658 | 10.728 | 10.799 | 10.870 | 10.941 | 11.013 | 11.085 | 11.158 |
| 13 | 11.231 | 11.305 | 11.379 | 11.453 | 11.528 | 11.604 | 11.680 | 11 756 | 11.833 | 11.910 |
| 14 | 11.987 | 12.065 | 12.144 | 12.223 | 12.302 | 12.382 | 12.462 | 12.543 | 12.624 | 12.706 |
| 15 | 12.788 | 12.870 | 12.953 | 13.037 | 13.121 | 13.205 | 13.290 | 13.375 | 13.461 | 13.547 |
| 16 | 13.634 | 13.721 | 13.809 | 13.898 | 13.987 | 14.076 | 14.166 | 14.256 | 14.347 | 14.438 |
| 17 | 14.530 | 14.622 | 14.715 | 14.809 | 14.903 | 14.997 | 15.092 | 15.188 | 15.284 | 15.380 |
| 18 | 15.477 | 15.575 | 15.673 | 15.772 | 15.871 | 15.971 | 16.071 | 16.171 | 16.272 | 16.374 |
| 19 | 16.477 | 16.581 | 16.685 | 16.789 | 16.894 | 16.999 | 17.105 | 17.212 | 17.319 | 17.427 |
| 20 | 17.535 | 17.644 | 17.753 | 17.863 | 17.974 | 18.085 | 18.197 | 18.309 | 18.422 | 18.536 |
| 21 | 18.650 | 18.765 | 18.880 | 18.996 | 19.113 | 19.231 | 19.349 | 19.468 | 19.587 | 19.707 |
| 22 | 19.827 | 19.948 | 20.070 | 20.193 | 20.316 | 20.440 | 20.565 | 20.690 | 20.815 | 20.941 |
| 23 | 21.068 | 21.196 | 21.324 | 21.453 | 21.583 | 21.714 | 21.845 | 21.977 | 22.110 | 22.243 |
| 24 | 22.377 | 22.512 | 22.648 | 22.785 | 22.922 | 23.060 | 23.198 | 23.337 | 23.476 | 23.616 |
| 25 | 23.756 | 23.897 | 24.039 | 24.182 | 24.326 | 24.471 | 24.617 | 24.764 | 24.912 | 25.060 |
| 26 | 25.209 | 25.359 | 25.509 | 25.660 | 25.812 | 25.964 | 26.117 | 26.271 | 26.426 | 26.582 |
| 27 | 26.739 | 26.897 | 27.055 | 27.214 | 27.374 | 27.535 | 27.696 | 27.858 | 28.021 | 28.185 |
| 28 | 28.349 | 28.514 | 28.680 | 28.847 | 29.015 | 29.184 | 29.354 | 29.525 | 29.697 | 29.870 |
| 29 | 30.043 | 30.217 | 30.392 | 30.568 | 30.745 | 30.923 | 31.102 | 31.281 | 31.461 | 31.642 |
| 30 | 31.824 | 32.007 | 32.191 | 32.376 | 32.561 | 32.747 | 32.934 | 33.122 | 33 312 | 33.503 |
| 31 | 33.695 | 33.888 | 34.082 | 34.276 | 34.471 | 34.667 | 34.864 | 35.062 | 35.261 | 35.462 |
| 32 | 35.663 | 35.865 | 36.068 | 36.272 | 36.477 | 36.683 | 36.891 | 37.099 | 37.308 | 37.518 |
| 33 | 37 729 | 37.942 | 38.155 | 38.369 | 33.584 | 38.801 | 39.018 | 39.237 | 39.457 | 39.677 |
| 34 | 39.898 | 40.121 | 40.344 | 40.569 | 40.796 | 41.023 | 41.251 | 41.480 | 41.710 | 41.942 |
| 35 | 42.175 | 42.409 | 42.644 | 42.880 | 43.117 | 43.355 | 43.595 | 43.836 | 44.078 | 44.320 |
| 36 | 44.563 | 44.808 | 45.054 | 45.301 | 45.549 | 45.799 | 46.050 | 46.302 | 46.556 | 46.811 |
| 37 | 47.067 | 47.324 | 47.582 | 47.841 | 48.102 | 48.364 | 48.627 | 48.891 | 49.157 | 49.424 |
| 38 | 49.692 | 49.961 | 50.231 | 50.502 | 50.774 | 51.048 | 51.323 | 51.600 | 51.879 | 52.160 |
| 39 | 52.442 | 52.725 | 53.009 | 53.294 | 53.580 | 53.867 | 54.156 | 54.446 | 54.737 | 55.030 |
| 40 | 55.324 | 55.61 | 55.91 | 56.21 | 56.51 | 56.81 | 57.11 | 57.41 | 57.72 | 58.03 |
| 41 | 58.34 | 58.65 | 58.96 | 59.27 | 59.58 | 59.90 | 60.22 | 60.54 | 60.86 | 61.18 |
| 42 | 61.50 | 61.82 | 62.14 | 62.47 | 62.80 | 63.13 | 63.46 | 63.79 | 64.12 | 64.46 |
| 43 | 64.80 | 65.14 | 65.48 | 65.82 | 66.16 | 66.51 | 66.86 | 67.21 | 67.56 | 67.91 |
| 44 | 68.26 | 68.61 | 68.97 | 69.33 | 69.69 | 70.05 | 70.41 | 70.77 | 71.14 | 71.51 |
| 45 | 71.88 | 72.25 | 72.62 | 72.99 | 73.36 | 73.74 | 74.12 | 74.50 | 74.88 | 75.26 |
| 46 | 75.65 | 76.04 | 76.43 | 76.82 | 77.21 | 77.60 | 78.00 | 78.40 | 78.80 | 79.20 |
| 47 | 79.60 | 80.00 | 80.41 | 80.82 | 81.23 | 81.64 | 82.05 | 82.46 | 82.87 | 83.29 |
| 48 | 83.71 | 84.13 | 84.56 | 84.99 | 85.42 | 85.85 | 86.28 | 86.71 | 87.14 | 87.58 |
| 49 | 88.02 | 88.46 | 88.90 | 89.34 | 89.79 | 90.24 | 90.69 | 91.14 | 91.59 | 92.05 |

| t, °C. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 92.51 | 97.20 | 102.09 | 107.20 | 112.51 | 118.04 | 123.80 | 129.82 | 136.08 | 142.60 |
| 60 | 149.38 | 156.43 | 163.77 | 171.38 | 179.31 | 187.54 | 196.09 | 204.96 | 214.17 | 223.73 |
| 70 | 233.7 | 243.9 | 254.6 | 265.7 | 277.2 | 289.1 | 301.4 | 314.1 | 327.3 | 341.0 |
| 80 | 355.1 | 369.7 | 384.9 | 400.6 | 416.8 | 433.6 | 450.9 | 468.7 | 487.1 | 506.1 |
| 90 | 525.76 | 527.76 | 529.77 | 531.78 | 533.80 | 535.82 | 537.86 | 539.90 | 541.95 | 544.00 |
| 91 | 546.05 | 548.11 | 550,18 | 552.26 | 554.35 | 556.44 | 558.53 | 560.64 | 562.75 | 564.87 |
| 92 | 566.99 | 569.12 | 571.26 | 573.40 | 575.55 | 577.71 | 579.87 | 582.04 | 584.22 | 586.41 |
| 93 | 588.60 | 590.80 | 593.00 | 595.21 | 597.43 | 599.66 | 601.89 | 604.13 | 606.38 | 608.64 |
| 94 | 610.90 | 613.17 | 615.44 | 617.72 | 620.01 | 622.31 | 624.61 | 626.92 | 629.24 | 631.57 |
| 95 | 633.90 | 636.24 | 638.59 | 640.94 | 643.30 | 645.67 | 648.05 | 650.43 | 652.82 | 655.22 |
| 96 | 657.62 | 660.03 | 662.45 | 664.88 | 667.31 | 669.75 | 672.20 | 674.66 | 677.12 | 679.69 |
| 97 | 682.07 | 684.55 | 687.04 | 689.54 | 692.05 | 694.57 | 697.10 | 699.63 | 702.17 | 704.71 |
| 98 | 707.27 | 709.83 | 712.40 | 714.98 | 717.56 | 720 15 | 722.75 | 725.36 | 727.98 | 730.61 |
| 99 | 733.24 | 735.88 | 738.53 | 741.18 | 743.85 | 746.52 | 749.20 | 751.89 | 754.58 | 757.29 |
| 100 | 760.00 | 762.72 | 765.45 | 768.19 | 770.93 | 773.68 | 776.44 | 779.22 | 782.00 | 784.78 |
| 101 | 787.57 | 790.37 | 793.18 | 796.00 | 798.82 | 801.66 | 804.50 | 807.35 | 810.21 | 813.08 |

*From the Physikalisch-technische Reichsanstalt, Holborn, Scheel, and Henning, "Wärmetabellen," Friedrich Vieweg & Sohn, Brunswick, 1909. By permission. For data at 50(0.2) 101.8°C., see "Handbook of Chemistry and Physics," 40th ed., p. 2326, Chemical Rubber Publishing Co. For a tabulation of temperature for pressures 700(1)779 mm. Hg, see Atack, "Handbook of Chemical Data," p. 117, Reinhold, New York, 1957. For a tabulation of pressure for 105(5)200(10)370°C., see Atack, p. 134, and for 100(1)374°C., see "Handbook of Chemistry and Physics," 40th ed., pp. 2328–2330, Chemical Rubber Publishing Co.

**TABLE 3-24 Total Vapor Pressures of Aqueous Solutions of $NH_3$***

Pressures are in pounds per square inch absolute

| t, °F. | Molal concentration of ammonia in the solutions in percentages (Weight concentration of ammonia in the solutions in percentages) | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 (0) | 5 (4.74) | 10 (9.50) | 15 (14.29) | 20 (19.10) | 25 (23.94) | 30 (28.81) | 35 (33.71) | 40 (38.64) | 45 (43.59) | 50 (48.57) | 55 (53.58) | 60 (58.62) | 65 (63.69) | 70 (68.79) | 75 (73.91) | 80 (79.07) | 85 (84.26) | 90 (89.47) | 95 (94.72) | 100 (100.00) |
| 32 | 0.09 | 0.34 | 0.60 | 0.97 | 1.58 | 2.60 | 4.20 | 6.54 | 9.93 | 14.18 | 19.40 | 25.16 | 31.16 | 36.77 | 42.72 | 45.94 | 49.28 | 52.14 | 54.90 | 58.01 | 62.29 |
| 40 | .12 | .45 | .77 | 1.24 | 2.01 | 3.25 | 5.21 | 8.06 | 12.05 | 17.20 | 23.39 | 30.20 | 37.20 | 43.73 | 49.60 | 54.43 | 58.33 | 61.64 | 64.78 | 68.32 | 73.32 |
| 50 | .18 | .64 | 1.05 | 1.65 | 2.67 | 4.29 | 6.75 | 10.35 | 15.34 | 21.65 | 29.26 | 37.54 | 45.93 | 53.85 | 60.87 | 66.67 | 71.29 | 75.25 | 79.07 | 83.41 | 89.19 |
| 60 | .26 | :86 | 1.42 | 2.21 | 3.51 | 5.55 | 8.65 | 13.22 | 19.30 | 27.05 | 36.26 | 46.23 | 56.32 | 65.90 | 74.06 | 80.96 | 86.49 | 91.08 | 95.69 | 100.66 | 107.6 |
| 70 | .36 | 1.17 | 1.84 | 2.90 | 4.56 | 7.13 | 11.01 | 16.56 | 24.05 | 33.39 | 44.42 | 56.44 | 68.46 | 79.54 | 89.36 | 97.51 | 104.08 | 109.60 | 114.86 | 120.63 | 128.8 |
| 80 | .51 | 1.52 | 2.43 | 3.76 | 5.85 | 9.06 | 13.86 | 20.61 | 29.69 | 40.96 | 54.08 | 68.19 | 82.55 | 95.69 | 107.20 | 116.54 | 124.30 | 130.64 | 136.40 | 143.72 | 153.0 |
| 90 | .70 | 2.02 | 3.15 | 4.83 | 7.43 | 11.40 | 17.23 | 25.48 | 36.34 | 49.82 | 65.32 | 81.91 | 98.61 | 114.02 | 127.42 | 138.34 | 147.15 | 154.56 | 161.81 | 169.76 | 180.6 |
| 100 | .95 | 2.62 | 4.05 | 6.13 | 9.34 | 14.22 | 21.32 | 31.16 | 44.12 | 59.99 | 78.30 | 97.68 | 117.17 | 135.01 | 150.50 | 163.16 | 173.40 | 182.10 | 190.22 | 199.22 | 211.9 |
| 110 | 1.27 | 3.34 | 5.14 | 7.72 | 11.64 | 17.58 | 26.07 | 37.81 | 53.16 | 71.87 | 93.19 | 115.7 | 138.10 | 158.84 | 176.54 | 191.15 | 203.26 | 212.89 | 222.34 | 232.85 | 247.0 |
| 120 | 1.69 | 4.27 | 6.46 | 9.63 | 14.42 | 21.54 | 31.69 | 45.62 | 63.59 | 85.33 | 110.2 | 136.2 | 162.08 | 185.70 | 206.29 | 222.68 | 236.37 | 247.38 | 258.40 | 270.1 | 286.4 |
| 130 | 2.22 | 5.38 | 8.07 | 11.91 | 17.67 | 26.20 | 38.25 | 54.55 | 75.55 | 100.86 | 129.5 | 159. | 189.00 | 215.88 | 239.33 | 258.40 | 273.3 | 286.4 | 298.67 | 311.9 | 330.3 |
| 140 | 2.89 | 6.70 | 9.98 | 14.63 | 21.49 | 31.54 | 45.73 | 64.78 | 89.19 | 118.24 | 151.3 | 185.4 | 219.28 | 249.66 | 276.15 | 297.81 | 315.0 | 329.4 | 343.2 | 358.6 | 379.1 |
| 150 | 3.72 | 8.29 | 12.23 | 17.81 | 26.00 | 37.81 | 54.43 | 76.61 | 104.65 | 138.1 | 175.4 | 214.5 | 252.65 | 287.24 | 317.3 | 341.7 | 361.1 | 377.1 | 392.8 | 409.8 | 432.2 |
| 160 | 4.74 | 10.16 | 14.92 | 21.54 | 31.16 | 45.02 | 64.25 | 89.88 | 122.10 | 160.2 | 202.7 | 247.0 | 290.18 | 329.4 | 363.1 | 390.2 | 412.2 | 430.4 | 447.8 | 466.6 | 492.8 |
| 170 | 5.99 | 12.41 | 18.01 | 25.87 | 37.11 | 53.27 | 75.55 | 104.84 | 141.75 | 185.1 | 233.2 | 283.1 | 331.7 | 375.6 | 413.3 | 443.7 | 467.8 | 488.7 | 508.2 | 528.8 | 558.4 |
| 180 | 7.51 | 15.00 | 21.65 | 30.86 | 44.02 | 62.68 | 88.17 | 121.68 | 163.7 | 212.6 | 267.0 | 323.1 | 377.1 | 426.6 | 468.4 | 502.4 | 529.5 | 552.3 | | | |
| 190 | 9.34 | 18.06 | 25.87 | 36.60 | 51.81 | 73.32 | 102.56 | 140.75 | 188.1 | 243.3 | 304.3 | 367.1 | 427.7 | 452.5 | 528.8 | | | | | | |
| 200 | 11.53 | 21.60 | 30.72 | 43.14 | 60.62 | 85.33 | 118.68 | 161.81 | 215.2 | 277.0 | 345.5 | 415.1 | 483.0 | 543.6 | | | | | | | |
| 210 | 14.12 | 25.61 | 36.26 | 50.58 | 70.72 | 98.80 | 136.42 | 185.10 | 245.1 | 314.5 | 390.7 | 468.4 | 542.9 | | | | | | | | |
| 220 | 17.19 | 30.27 | 42.47 | 59.00 | 81.91 | 113.81 | 156.41 | 211.24 | 278.2 | 355.1 | 439.6 | 525.5 | | | | | | | | | |
| 230 | 20.78 | 35.59 | 49.60 | 68.46 | 94.43 | 130.64 | 178.28 | 239.70 | 314.5 | 400.2 | 493.4 | | | | | | | | | | |
| 240 | 24.97 | 41.52 | 57.65 | 78.91 | 108.60 | 149.20 | 202.74 | 270.92 | 354.1 | 448.9 | 552.3 | | | | | | | | | | |
| 250 | 29.83 | 48.32 | 66.67 | 90.74 | 124.08 | 169.48 | 229.62 | 305.60 | 397.6 | 502.4 | | | | | | | | | | | |

* Wilson, *Univ. Ill., Eng. Expt. Sta. Bull.* 146.

**TABLE 3-25 Partial Pressures of $H_2O$ over Aqueous Solutions of Sodium Carbonate**

mmHg

| t, °C. | %$Na_2CO_3$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| 0 | 4.5 | 4.5 | | | | | |
| 10 | 9.2 | 9.0 | 8.8 | | | | |
| 20 | 17.5 | 17.2 | 16.8 | 16.3 | | | |
| 30 | 31.8 | 31.2 | 30.4 | 29.6 | 28.8 | 27.8 | 26.4 |
| 40 | 55.3 | 54.2 | 53.0 | 57.6 | 50.2 | 48.4 | 46.1 |
| 50 | 92.5 | 90.7 | 88.7 | 86.5 | 84.1 | 81.2 | 77.5 |
| 60 | 149.5 | 146.5 | 143.5 | 139.9 | 136.1 | 131.6 | 125.7 |
| 70 | 239.8 | 235 | 230.5 | 225 | 219 | 211.5 | 202.5 |
| 80 | 355.5 | 348 | 342 | 334 | 325 | 315 | 301 |
| 90 | 526.0 | 516 | 506 | 494 | 482 | 467 | 447 |
| 100 | 760.0 | 746 | 731 | 715 | 697 | 676 | 648 |

**TABLE 3-26 Partial Pressures of $H_2O$ and $CH_3OH$ over Aqueous Solutions of Methyl Alcohol***

| Mole fraction $CH_3OH$ | 39.9°C. | | Mole fraction $CH_3OH$ | 59.4°C. | |
|---|---|---|---|---|---|
| | $P_{H_2O}$, mm. Hg | $P_{CH_3OH}$, mm. Hg | | $P_{H_2O}$, mm. Hg | $P_{CH_3OH}$, mm. Hg |
| 0 | 54.7 | 0 | 0 | 145.4 | 0 |
| 14.99 | 39.2 | 66.1 | 22.17 | 106.9 | 210.1 |
| 17.85 | 38.5 | 75.5 | 27.40 | 102.2 | 240.2 |
| 21.07 | 37.2 | 85.2 | 33.24 | 96.6 | 272.1 |
| 27.31 | 35.8 | 100.6 | 39.80 | 91.7 | 301.9 |
| 31.06 | 34.9 | 108.8 | 47.08 | 84.8 | 335.6 |
| 40.1 | 32.8 | 127.7 | 55.5 | 76.9 | 373.7 |
| 47.0 | 31.5 | 141.6 | 69.2 | 57.8 | 439.4 |
| 55.8 | 27.3 | 153.4 | 78.5 | 43.8 | 486.6 |
| 68.9 | 20.7 | 186.6 | 85.9 | 30.1 | 526.9 |
| 86.0 | 10.1 | 225.2 | 100.0 | 0 | 609.3 |
| 100.0 | 0 | 260.7 | | | |

* "International Critical Tables," vol. 3, p. 290, McGraw-Hill.

**TABLE 3-27 Partial Pressures of $H_2O$ over Aqueous Solutions of Sodium Hydroxide**

mmHg

| Conc. g. NaOH/100 g. $H_2O$ | Temperature, °C. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 20 | 40 | 60 | 80 | 100 | 120 | 160 | 200 | 250 | 300 | 350 |
| 0 | 4.6 | 17.5 | 55.3 | 149.5 | 355.5 | 760.0 | 1,489 | 4,633 | 11,647 | 29,771 | 64,200 | 123,600 |
| 5 | 4.4 | 16.9 | 53.2 | 143.5 | 341.5 | 730.0 | 1,430 | 4,450 | 11,200 | 28,600 | 61,800 | 118,900 |
| 10 | 4.2 | 16.0 | 50.6 | 137.0 | 325.5 | 697.0 | 1,365 | 4,260 | 10,750 | 27,500 | 59,300 | 114,100 |
| 20 | 3.6 | 13.9 | 44.2 | 120.5 | 288.5 | 621.0 | 1,225 | 3,860 | 9,800 | 25,300 | 54,700 | 105,400 |
| 30 | 2.9 | 11.3 | 36.6 | 101.0 | 246.0 | 537.0 | 1,070 | 3,460 | 8,950 | 23,300 | 50,800 | 98,000 |
| 40 | 2.2 | 8.7 | 28.7 | 81.0 | 202.0 | 450.0 | 920 | 3,090 | 8,150 | 21,500 | 47,200 | 91,600 |
| 50 | ... | 6.3 | 20.7 | 62.5 | 160.5 | 368.0 | 770 | 2,690 | 7,400 | 19,900 | 44,100 | 85,800 |
| 60 | ... | 4.4 | 15.5 | 47.0 | 124.0 | 294.0 | 635 | 2,340 | 6,750 | 18,400 | 41,200 | 80,700 |
| 70 | ... | 3.0 | 10.9 | 34.5 | 94.0 | 231.0 | 515 | 2,030 | 6,100 | 17,100 | 38,700 | 76,000 |
| 80 | ... | 2.0 | 7.6 | 24.5 | 70.5 | 179.0 | 415 | 1,740 | 5,500 | 15,800 | 36,300 | 71,900 |
| 90 | ... | 1.3 | 5.2 | 17.5 | 53.0 | 138.0 | 330 | 1,490 | 5,000 | 14,700 | 34,200 | 68,100 |
| 100 | ... | 0.9 | 3.6 | 12.5 | 38.5 | 105.0 | 262 | 1,300 | 4,500 | 13,650 | 32,200 | 64,600 |
| 120 | ... | .... | 1.7 | 6.3 | 20.5 | 61.0 | 164 | 915 | 3,650 | 11,800 | 28,800 | 58,600 |
| 140 | ... | .... | .... | 3.0 | 11.0 | 35.5 | 102 | 765 | 2,980 | 10,300 | 25,900 | 53,400 |
| 160 | ... | .... | .... | 1.5 | 6.0 | 20.5 | 63 | 470 | 2,430 | 8,960 | 23,300 | 49,000 |
| 180 | ... | .... | .... | ..... | 3.5 | 12.0 | 40 | 340 | 1,980 | 7,830 | 21,200 | 45,100 |
| 200 | ... | .... | .... | ..... | 2.0 | 7.0 | 25 | 245 | 1,620 | 6,870 | 19,200 | 41,800 |
| 250 | ... | .... | .... | ..... | 0.5 | 2.0 | 8 | 110 | 985 | 5,000 | 15,400 | 35,000 |
| 300 | ... | .... | .... | ..... | 0.1 | 0.5 | 2.7 | 50 | 610 | 3,690 | 12,500 | 29,800 |
| 350 | ... | .... | .... | ..... | ..... | ..... | 0.9 | 23 | 380 | 2,750 | 10,300 | 25,700 |
| 400 | ... | .... | .... | ..... | ..... | ..... | ..... | 11 | 240 | 2,080 | 8,600 | 22,400 |
| 500 | ... | .... | .... | ..... | ..... | ..... | ..... | ..... | 100 | 1,210 | 6,100 | 17,500 |
| 700 | ... | .... | .... | ..... | ..... | ..... | ..... | ..... | ..... | 440 | 3,300 | 11,500 |
| 1000 | ... | .... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1,470 | 6,800 |
| 2000 | ... | .... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 150 | 1,760 |
| 4000 | ... | .... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 120 |
| 8000 | ... | .... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 7 |

APPENDIX B

# JTBaker.com TECHNICAL LIBRARY Selection Guide

J.T.Baker

222 Red School Lane
Phillipsburg, NJ 08865 USA
www.jtbaker.com
www.solvitcenter.com
Phone: 1-800-JTBAKER (582-2537)
Fax: 908-859-6905

## Desiccant Selection Guide

| Drying Agent | Product Number | Size | Suitable for Drying | Not Suitable for Drying | Residual Water mg $H_2O$/L Dried Air | g $H_2O$/g Desiccant | Regeneration | Reaction Mechanism |
|---|---|---|---|---|---|---|---|---|
| Aluminum Oxide | 0536-01<br>0536-05 | 500g<br>2.5 kg | Hydrocarbons, air, ammonia, argon, helium, nitrogen, oxygen, Freon, $H_2O$, $CO_2$, $SO_2$ | | 0.003 | 0.2 | 175°C | Chemisorption Adsorption |
| ANHYDRONE® (Magnesium Perchlorate anhydrous) | 0828-01 | 500 g | Inert gas, air | ** Most Organics | 0.001 | 0.2 | 250°C with Vacuum | Hydration |
| Barium Oxide | B656-04 | 125 g | Organic bases, alcohols, aldehydes, amines | Acidic Compounds, $CO_2$ | 0.00065 | 0.1 | Not Recommended | Absorption and Adsorption |
| Boric Anhydride | 1176-01<br>1176-05 | 500 g<br>2.5 kg | Formic Acid | | | 0.8 | 450°C | |
| Calcium Chloride (20 Mesh) | 1311-01<br>1311-05 | 500 g<br>2.5 kg | Alkyl and Aryl Halides, most esters, saturated and aromatic hydrocarbons, ethers | Alcohols, amines, phenols, aldehydes, amides, amino acids, some esters, ketones | 0.14-0.25 | 0.2 ($1H_2O$)<br>0.3 ($2H_2O$) | 250°C | Hydration |
| Calcium Chloride (4-8 Mesh) | 1313-01<br>1313-05 | 500 g<br>2.5 kg | Alkyl and Aryl Halides, most esters, saturated and aromatic hydrocarbons, ethers | Alcohols, amines, phenols, aldehydes, amides, amino acids, some esters, ketones | 0.14-0.25 | 0.2 ($1H_2O$)<br>0.3 ($2H_2O$) | 250°C | Hydration |
| Calcium Oxide | 1410-01<br>1410-05 | 500 g<br>2.5 kg | Alcohols, amines and ammonia gas | Acidic compounds, esters | 0.007 | 0.3 | 1000°C | Chemisorption |
| Calcium Sulfate | 1458-01 | 500 g | Most organic compounds | | 0.005 | 0.066 | 235°C | Absorption |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Cupric Sulfate | 1850-01<br>1850-05 | 500 g<br>2.5 kg | Esters, alcohols (excellent for benzene and toluene) | | 1.4 | 0.6 | 200°C | |
| DRIERITE, Regular | L056-07<br>L056-02 | 454 g<br>2.3 kg | Air, industrial gases, refrigerants, organic liquids and solids. | | 0.005 | 0.066 | 210°C for 1 hour | Hydration |
| DRIERITE, Indicating (4 Mesh)<br>(8 Mesh)<br>(10-20 Mesh) | L057-07<br>L057-02<br>L058-07<br>L058-02<br>L059-07 | 454 g<br>2.3 kg<br>454 g<br>2.3 kg<br>454 g | Air, industrial gases, refrigerants, organic liquids and solids. | | 0.005 | 0.066 | 210°C for 1 hour | Hydration |
| Lithium Aluminum Hydride | P403-05 | 100 g | Aldehydes, ketones, esters, carboxylic acids, peroxides, acid anhydrides, acid chlorides, ethers | Acid and its derivatives, aromatic nitro compounds | | | | |
| Magnesium Oxide | 2476-01 | 500 g | Hydrocarbons, aldehydes, alcohols, basic gases, amines | Acidic compounds | 0.008 | 0.5 | 800°C | Hydration |
| Magnesium Sulfate | 2506-01<br>2506-05 | 500 G<br>2.5 kg | Most compounds, incl. Acids, ketones, aldehydes, esters, nitriles | Acid sensitive compounds | 1.0 | 0.2·0.8 | 200°C and red heat | Hydration |
| Molecular Sieve Activated Type 3A 8-12 Mesh | 2710-01<br>2710-05 | 500 g<br>2.5 kg | Molecules of diameter >3 angstroms | Molecules of diameter <3 angstroms | | 0.18 | 117-260°C | Adsorption |
| Molecular Sieve Activated 8-12 Mesh Indicating Type 4A | 2707-01<br>2708-01<br>2708-05 | 500 g<br>500 g<br>2.5 kg | Molecules of diameter >4 angstroms | Molecules of diameter <4 angstroms, Ethanol, $H_2S$, $CO_2$, $SO_2$, $C_2H_4$, $C_3H_4$, and strong acids | 0.001 | 0.18 | 250°C | Adsorption |
| Molecular Sieve Activated (8-12 Mesh) Type 5A | 2709-01<br>2709-05 | 500g<br>2.5 kg | Molecules of diameter > 5 angstroms, e.g., branched chain compounds and those having 4 carbon or larger rings | Molecules of diameter <5 angstroms, e.g., butanol, n-$C_4H_{10}$ to n-$C_{22}H_{46}$ | 0.003 | 0.18 | 250°C | Adsorption |
| Phosphoric Acid | 0260-01<br>0260-03 | 500ml<br>2.5 L | | | 0.003 | | Not recommended | Absorption and Solution |
| Phosphorous Pentoxide | 2155-01 | 500 g | Saturated hydrocarbons, aromatic hydrocarbons, ethers, alkyl halides, aryl halides, nitriles, anhydrides, nitrites, esters | Alcohols, acids, amines, ketones, HF and HCl vapors | $3x10^{-5}$ | 0.5 | No | Chemisorption leading to $H_3PO_4$ |
| Potassium Carbonate | 3012-01 | 500 g | Alcohols, nitriles, ketones, esters, | Acids, phenols | | 0.2 | 300° C | Hydrate Formation |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3012-05 | 2.5 kg | amines | | | | | |
| Potassium Hydroxide | 3140-01<br>3140-05<br>3140-07 | 500 g<br>2.5 kg<br>12 kg | Amines, organic bases | Acids, phenols, esters, amides, acidic gases, aldehydes | 0.3 | Indeterminate | No | Hydration and Solution Formation |
| Silica Gel Indicating 6-16 Mesh | 3401-01<br>3401-05 | 500 g<br>2.5 kg | Most organics | HF vapors | 0.03 | 0.2 | 200-350°C | Adsorption |
| Sodium | 9410-04<br>9410-01 | 113 g<br>454 g | Saturated and aromatic hydrocarbons, ethers | Acids, alcohols, aldehydes, ketones, amines, esters, organic halides, and any substance with high water content | | | Not Recommended | Leads to $NaOH + H_2$ |
| Sodium Hydroxide Pellets | 3722-01<br>3722-05<br>3722-07 | 500 g<br>2.5 g<br>12 kg | Amines | Acids, phenols, esters, amides | 0.16 | Indefinite | Not Recommended | Absorption and Solution Formation |
| Sodium Sulfate Anhydrous Granular Powder | 3891-01<br>3891-05<br>3891-07 | 500 g<br>2.5 kg<br>12 kg | Alkyl halides, aryl halides, aldehydes, ketones, acids | | 12 | 1.2 | 150°C | Hydration |
| Sodium Sulfate Anhydrous Powder | 3898-01<br>3898-05<br>3898-07 | 500 g<br>2.5 kg<br>12 kg | Alkyl halides, aryl halides, aldehydes, ketones, acids | | 12 | 1.2 | 150°C | Hydration |
| Sodium Sulfate Anhydrous Granular (12-60 mesh) | 3375-01<br>3375-05<br>3375-07 | 500 g<br>2.5 kg<br>12 kg | Alkyl halides, aryl halides, aldehydes, ketones, acids | | 12 | 1.2 | 150°C | Hydration |
| Sulfuric Acid | 9681-01<br>9681-03 | 500ml<br>2.5 L | Inert gases, HCl, $Cl_2$, CO, $SO_2$, air used in desiccators | Too reactive to actually contact organic materials | 0.003 | Indefinite | No | Hydration |
| Zinc Chloride Reagent, Broken Lump | 4321-01<br>4321-05<br>4321-07 | 500 g<br>2.5 kg<br>12 kg | Hydrocarbons | Ammonia, amines, alcohol | 0.9 | 0.2 | 110°C | Hydration |

** May form explosive compound when exposed to organic vapors.



Lit #3045